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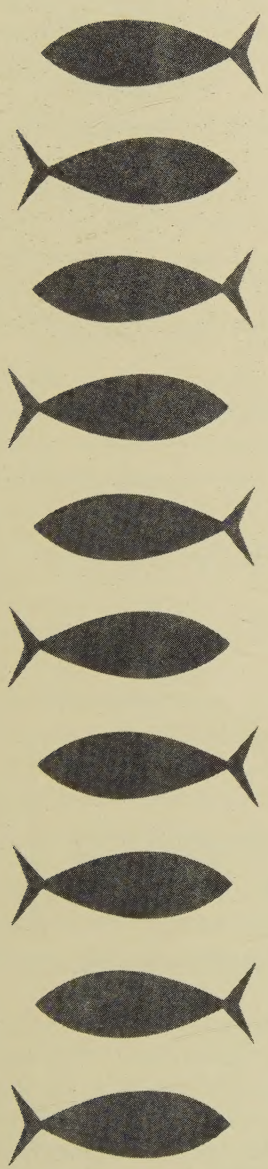

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ANTARCTIC ECOSYSTEM RESEARCH GROUP

La Jolla, California

SWFSC to Host CCAMLR Meetings in 1997

Division Chief Rennie Holt and Fishery Biologist George Watters were members of the U.S. delegation to the fifteenth meeting of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) held in Hobart, Tasmania, October 21 to November 1, 1996. This report provides a summary of the results of the meeting.

During the last fishing season, 8,826 tons of finfish, 118,714 tons of krill, 497 tons of crab, and 52 tons of squid were taken by commercial fisheries in CCAMLR waters. Almost all of the finfish taken was Patagonian toothfish (*Dissostchus eleginoides*) harvested by Chile and France in waters around South Georgia and Kerguelen Islands.

The major harvesting issue faced by the commission was notification by six countries of their intent to initiate new fisheries in 1996/97: a squid fishery by the United Kingdom and Korea and longline fisheries for D. eleginoides by South Africa, Australia, New Zealand, and Norway. The longline fisheries will occur in several statistical subareas and divisions (management areas for CCAMLR). To regulate these new fisheries, CCAMLR developed an integrated approach which set regulations by area instead of for each country. Regulations included total allowable catch limits (1,980 tons in most areas), provisions to distribute fishing effort over a wide geographic area by permitting a nominal level of exploitation in several fine-scale areas (0.5 degree latitude by 1.0 degree longitude), requirements for vessel observers and monitoring, and use of fishery practices to reduce bird mortality.

Twenty-one new or amended conservation measures (regulation measures) were adopted, including measures regarding D. eleginoides and mackerel icefish (*Champsocephalus gunnari*). The latter measure sets a catch limit of 1,300 tons and a by-catch limit for other species, prohibits use of bottom trawls, and prescribes a limited season from May to November 1997.

The commission noted that the U.S. vessel fishing for crab during the 1995/96 season ceased because the fishing company did not consider the fishery to be economically viable. Because several companies from the United States and other countries have expressed considerable interest in participating in the fishery, the commission continued and modified a conservation measure regulating the crab fishery.

The commission was unable to agree to the text of a U.S.-sponsored measure governing the resumption of fisheries that have been closed or lapsed. Commission members and the Scientific Committee were urged to give priority attention to this topic at the next meeting.

The United States agreed to host several meetings at the Southwest Fisheries Science Center (SWFSC) in La Jolla, California, during the intercessional period. The meetings will include a group of scientists conducting research in CCAMLR statistical area 48 (the Peninsula, South Orkney Island, and South Georgia Island) and joint research in the Elephant Island area, a subgroup on statistical matters, and a working group on monitoring and management. (R. Holt, 619-546-5601)

COASTAL FISHERIES RESOURCES DIVISION

La Jolla, California

Mitochondrial DNA Techniques Used to Identify Larval Rockfishes

Graduate student Cindy Taylor has used genetic methods to individually identify seven species of larval rockfishes which previously could be identified only collectively by a characteristic black spot on the dorsal fin.

The seven rockfish species in the study group were the widow (*Sebastes entomelas*), yellowtail (*S.flavidus*), black (*S. melanops*), vermilion (*S. miniatus*), blue (*S. mystinus*), canary (*S. pinniger*), and olive (*S. serranoides*) rockfishes. Molecular identification techniques were used to differentiate DNA sequence data (the first 800 base pairs of the cytochrome b gene) in this group. DNA frag-

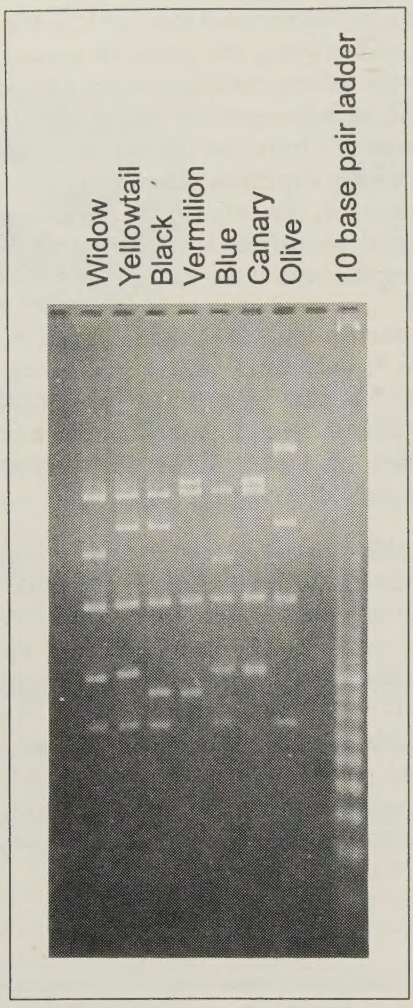

Figure 1. Restriction patterns of mitochondrial cytochrome b gene for seven species of larval rockfishes.

ments were then amplified and visualized using ethidium bromide under ultraviolet light (Fig. 1).

As seen in the Figure 1, species-specific recognition sites for three enzymes provided unique banding patterns for each of the seven species. The protocol is now being tested on multiple individuals to determine intraspecific polymorphism prior to using the technique to verify identifications of juveniles collected during rockfish cruises conducted in May-June 1996. This promising and economical method of species identification using molecular techniques will allow Tiburon Laboratory scientists to incorporate these additional rockfish species into a modified egg-production model for estimating biomass. (R. Vetter, 619-546-7125)

MARINE MAMMAL DIVISION

La Jolla, California

Whale Habitat and Prey Study Completed

Blue whales are common visitors to the western Channel Islands off California from June through September, where they come to feed on dense swarms of krill. To learn more about how blue whales use these summer feeding grounds and what this activity might mean for the global recovery of blue whale stocks, the Marine Mammal Division conducted a Whale Habitat and Prey Study aboard the NOAA research vessel *David Starr Jordan* from July 10 through August 4, 1996. This study, like one in August of last year, was designed to study the distribution and activities of blue whales and other large whales, to survey the distribution of prey organisms (krill), and to measure physical and biological habitat variables that influence the distribution of whales and prey. The cruise was divided into a large-scale survey (10 days) between stations separated by 23 miles and a small-scale survey around the Channel Islands where blue whales feed (13 days).

Researchers made 314 blue whale sightings, almost all on the north side of San Miguel and Santa Rosa Islands (Fig. 1). Other whale sightings included 20 humpback whales, 16 fin whales, 11 minke whales, and 91 unidentified balaenopterids (probably blue whales, but may have been fin whales). Thirty-two blue whales were photographed for identification with individuals in a catalog maintained by Cascadia Research. Biopsy samples for genetic analysis of stock affinity were collected from 19 blue whales, eight fin whales, six bottlenose dolphins, and one Pacific white-sided dolphin. Dolphin sightings included 99 common dolphin, 61 Risso's dolphin, and 40 Pacific white-sided dolphin.

Krill were sampled with a three-frequency Simrad EK-500 echo sounder by scientists from the Antarctic Ecosystem Research Group. An Isaacs-Kidd midwater trawl was used to make oblique tows at the large-scale grid stations. A 1-meter multiple opening-closing net environmental sampling system was used to sample observed acoustic targets during the small-scale survey. Dense layers of the euphausiid *Euphausia pacifica* were found ex-

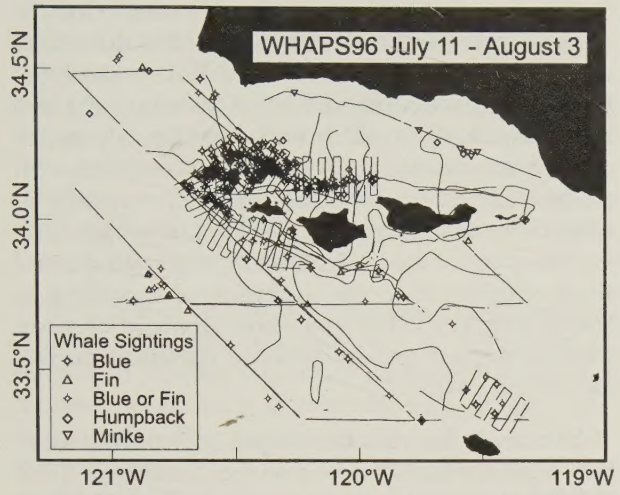

Figure 1. WHAPS96 on-effort tracklines and whale sightings.

tending off the shelf edge on the north side of the islands. On the broad shelf off the northwest side of San Miguel Island, where blue whales were most abundant, dense patches of the larger euphausiid *Thysanoessa spinifera* were found.

The Channel Islands National Marine Sanctuary's research vessel *Ballena* was used to explore whale feeding behavior. Scientists from the University of California at Santa Cruz spent three weeks tagging blue whales with radio tags that recorded time and depth and allowed tracking of a whale's position when it surfaced. Four whales were tagged and tracked during the study. Operations were hampered on many days by strong northwesterly winds. The *Ballena* was equipped with a two-frequency echo sounder to detect krill in the vicinity of the tagged whales. Recovered tags showed that whales dived into and moved through krill swarms both near the bottom on the shelf and off the shelf edge.

Oceanographic sampling consisted of 80 conductivity-temperature-depth (CTD) casts for 698 chlorophyll samples, 701 nutrient samples, and 119 primary productivity samples. These data showed the water over the shelf on the feeding grounds had been upwelled along the coast north of Point Conception, where strong winds blow from the northwest during summer. The upwelled water is cold and well-mixed and therefore is rich in nutrients and supports a high rate of primary productivity by phytoplankton. The oceanographic and bathymetric characteristics of the northwestern Channel Islands result in dense patches of krill which make this a critical habitat for the world's largest stock of blue whales. (P. Fiedler, 619-546-7016)

HONOLULU LABORATORY

Honolulu, Hawaii

PROTECTED SPECIES INVESTIGATION

Open House Held Aboard *Townsend Cromwell*

An open house, sponsored by the Honolulu Laboratory in celebration of the 125th anniversary of the National Marine Fisheries Service (NMFS), was held on Labor Day 1996 aboard the NOAA research vessel *Townsend Cromwell*. Long-time employees of the Honolulu Laboratory characterized this celebration, held at Pier 9 of the Aloha Tower Marketplace in downtown Honolulu, as one of the laboratory's most successful open houses.

An estimated 1,000 visitors toured the 164-ft ship, learning firsthand from laboratory staff and *Townsend Cromwell* crew members about NMFS ocean-going research activities in the western Pacific and the vital role the *Townsend Cromwell* plays in these activities. Laboratory displays included a planktonic life-history poster in the wet lab, a longline economics poster with associated longline gear and lobster fishing gear on the foredeck, a scuba sled video presentation in the vessel's lounge area, a satellite oceanographic and fisheries recruitment poster and display in the electronics lab, and a turtle poster and display and a monk seal poster and "critter cam" video in the galley.

Townsend Cromwell spends about 240 days at sea annually as the primary research platform in the Honolulu Laboratory's effort to conserve and recover the Hawaiian monk seal and marine turtle populations, to manage viable fishery stocks, and to protect marine life habitats. (M. Higa, 808-943-1211)

PACIFIC FISHERIES ENVIRONMENTAL GROUP

Pacific Grove, California

Paper Completed on Nearshore Assemblages of Young Rockfishes and Their Physical Environment off Central California during the 1991-93 El Niño

Rockfishes (*Sebastes* spp.) are tremendously diverse, dominate coastal benthic assemblages and support heavily exploited recreational and commercial fisheries in California. Although rockfish larvae are one of the most prevalent groups in nearshore ichthyoplankton assemblages, especially off central California, their abundance varies widely from year to year. Warm climatological events like El Niño can have substantial effects on recruitment by altering reproduction, larval distribution and abundance, and prey and predator production.

A study to evaluate distribution and abundance of rockfish larvae and associated hydrography on small spatial (<20 km) and temporal (biweekly to monthly) scales was conducted in an upwelling center north of Monterey Bay during an extended El Niño event. Secondary objectives were to assess hatch date distributions of early larvae and pelagic juveniles (May-July) of common species, potential larval transport mechanisms, and subsequent strength and timing of nearshore juvenile recruitment. This project was supported by the California Sea Grant Program, with collaboration among research biologists from the Pacific Fisheries Environmental Group (Mary Yoklavich), Moss Landing Marine Laboratories (Valerie Loeb, Mary Nishimoto, Brendan Daly, and Greg Cailliet), and California Department of Fish and Game (David VenTresca).

The prolonged El Niño event resulted in anomalously warm, low salinity water to depths over 50 m in nearshore areas, suggesting onshore displacement of the California Current. Upwelling was reduced and delayed, without the usual persistent upwelling plumes in the survey area. Larval rockfish abundance was similar in both years (winter-spring of 1991-92 and 1992-93), peaking in early February, and was among the highest observed when compared with California Cooperative Oceanic Fisheries Investigations (CalCOFI) estimates from central California for 1951-84. Based on larval ages, the dominant species (shortbelly rockfish) hatched from December to April, with median hatch dates in mid-February both years. Growth rates of shortbelly rockfish larvae did not differ among months or between years. Relative to 1993, however, rockfish larvae were more abundant and larval shortbelly rockfish were significantly larger at onshore stations in 1992. This coincided with onshore advection of water (namely, reversals in wind direction, warmer and less saline water) during the onset of the El Niño event, suggesting nearshore retention of larvae. Initiation of upwelling in March and April 1993 and fewer larvae at onshore stations suggest greater offshore transport during the second year.

Extremely low numbers of pelagic juvenile rockfish were encountered in summer months of 1992 (2.3 fish per trawl in 56 midwater trawls). In 1993 pelagic juveniles were 20 times more abundant (75.1 fish per trawl in 64 midwater trawls), comprised twice as many taxa, and were substantially larger than in 1992. Juvenile shortbelly rockfish collected were born late in the season during both years (median hatch dates of April 21, 1992 and March 31, 1993); upwelling occurred coincidentally during this period in 1993 but not in 1992. Limited information on abundance of chaetognaths, a potential predator, indicated high numbers nearshore in February 1992. Much higher survival and recruitment of juveniles in 1993 were likely due to increased offshore transport and perhaps lower predation during the larval stages. The results of this study have been published in Fishery Bulletin, U.S. (M. Yoklavich, 408-648-9036)

Synopsis of 50 Years of Coastal Upwelling Indices Completed

The frictional stress of equatorward wind on the ocean's surface, in concert with the earth's rotation, causes water in the surface layer to move away from the west coast of continents. This water is replaced by water which upwells near the coast from depths of 50-100 m and more. Upwelled water is cooler and more saline than the original surface water and typically has much higher levels of nutrients that are key to sustaining the high biological productivity of eastern boundary current marine ecosystems. Temporal variations in upwelling over seasonal to interannual and longer periods due to large-scale shifts in wind patterns and atmospheric systems are linked to variability in fish populations and other biological components in coastal ocean ecosystems.

Since the early 1970s, PFEG has generated indices of the intensity of large-scale, wind-induced coastal upwelling at 15 standard locations along the west

coast of North America. The indices are based on estimates of offshore Ekman transport driven by geostrophic wind stress, which are derived from six-hourly synoptic and monthly mean surface atmospheric pressure fields. The pressure fields are interpolated from Northern Hemisphere surface observations and are provided by the U.S. Navy Fleet Numerical Meteorology and Oceanography Center, Monterey, California.

Two sets of upwelling index time series are calculated. One set (1967-present) is comprised of daily and weekly means of six-hourly upwelling indices. Availability of synoptic data prior to 1967 is limited. The second set of indices contains monthly time series derived from monthly mean pressure fields (1946-present). The synoptic fields used to construct the monthly mean fields prior to July 1962 were acquired from a variety of sources, rather than the oceanography center. Four NOAA Technical Memoranda describe the methods used to calculate the indices and summarize the upwelling time series; the latest in this series, which is now available, describes the history and derivation of the upwelling index and highlights 50 years of the series.

PFEG regularly produces and provides index time series to scientists and managers concerned with marine ecosystems and biota. The indices are distributed to about 50 regular users each month, and each year 40-50 requests are received for upwelling data or information on how they are derived (Fig. 1). These series have been used in scores of studies and scientific publications, including studies to describe coastal circulation, El Niño/Southern Oscillation, and climate change, as well as studies of linkages between environmental and biological variability of zooplankton, crabs, groundfish, small pelagics, salmon, and marine birds.

In the latest report, the shape of the annual cycle is estimated at each of the 15 standard upwelling locations by a least-squares regression of the daily data from 1967-91 to an annual and semiannual harmonic signal. The characteristics of the annual upwelling cycle at each point are summarized in Figure 2. The North American west coast appears to break down into three distinct upwelling regions: Baja California (21-30°N), continental United States (30-48°N), and British Columbia and Alaska (48-60°N). The annual range off Baja California is relatively small, with wintertime values of less than 50 $m^3/s/100m$ and summer maxima of 75-150 $m^3/s/100m$. This region is also characterized by secondary minima and maxima in August and October, respectively (more technically a pair of inflec-

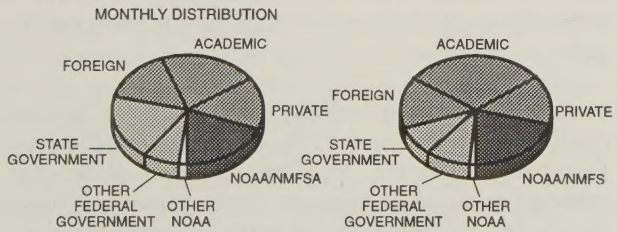

Figure 1. Charts showing distribution of users of upwelling index data and related information, by their type of affiliation. The left-hand chart shows distribution of individuals receiving upwelling products on a monthly basis. The right-hand chart shows distribution of special requests for upwelling products or information.

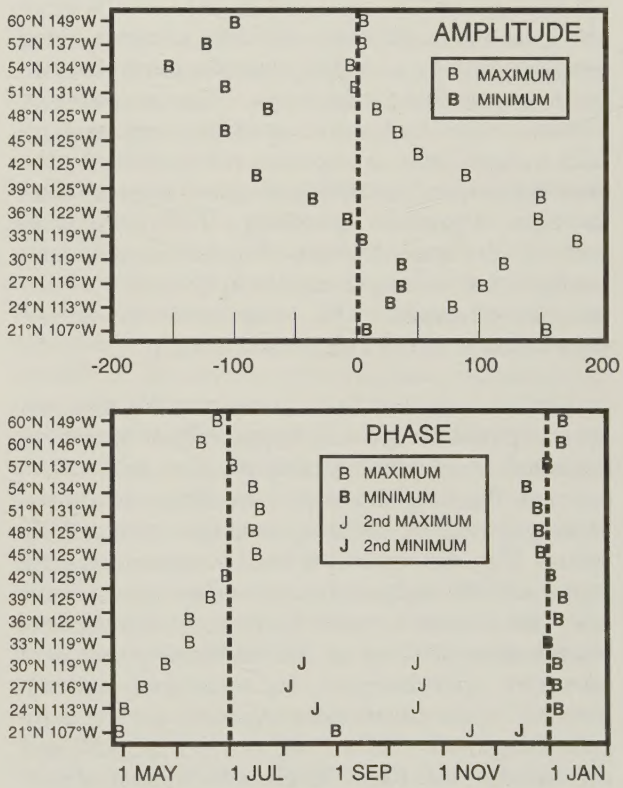

Figure 2. Characteristics of annual cycle of daily upwelling, based on biharmonic fits for period 1967-91. The upper panel shows maximum and minimum amplitudes of annual cycle at each position. The lower panel shows calendar dates of maxima and minima at all locations, and secondary maxima and minima for 21-30°N. Units are $m^3/s/100m$.

tion points in the annual curves at 27°N and 30°N). In contrast, annual cycles north of 30°N have a strong sinusoidal (12-month harmonic) signature. The greatest upwelling rates occur at 33°N, with a linear decrease in the maximum upwelling indices north to about 54°N. The greatest annual range occurs at 39°N. Maximum values north of Washington are about zero, and occur in June-July. Minimum indices of about -100 $m^3/s/100m$ occur in about January 1.

The time of minimum upwelling occurs within about 15 days of January 1 along the entire coast. The time of strongest upwelling increases from late April off Baja to mid-July off Oregon and Washington, a lag of about 80 days (approximately 30 km per day). The phase of maximum upwelling corresponds with certain climatological surface ocean conditions along the coast and oceanographic data which were developed by SWFSC scientist Ron Lynn from CalCOFI sampling data. Maximum salinity occurs in May off northern Baja, in June-July off southern California, and in July and August along central California. Salinity maxima along southern Baja occur in fall, coinciding with the secondary upwelling maximum. The temperature mimima found by Lynn in upwelling regions, typically in April-May, is impacted substantially by the seasonal surface heat flux and agrees less well with the time of greatest upwelling. The relationship between the annual cycles of upwelling and temperature and salinity is also complicated by advection along the coast and is influenced by the surface water masses of the California Current.

Annual cycles for the daily and monthly data sets are compared in Figure 3. It appears that upwelling indices derived from monthly pressure fields overestimate the magnitude of upwelling and downwelling based on monthly averages of the daily values. This discrepancy is most evident during the months of the highest absolute values at each location (for instance, monthly indices overestimate winter downwelling at the northern points and summer upwelling at the southern points). Monthly stress calculations overestimate the daily upwelling rates off Alaska by as much as 130%, and off southern and Baja California by a factor of two. With 25 years of simultaneous daily and monthly data now available, our preliminary interpretation, as reflected in Figure 3, is that the relative discrepancy between the two data sets varies with season as well as latitude. A more complete analysis is being developed that will allow the monthly indices to be adjusted temporally and spatially to reflect more realistic estimates of coastal upwelling.

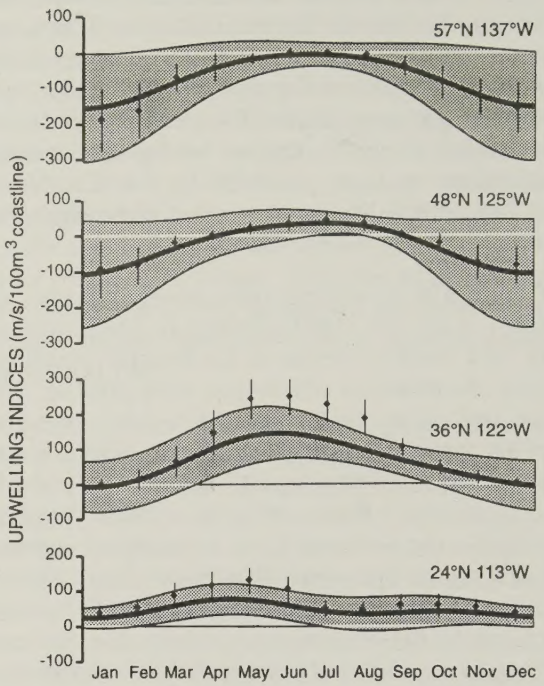

Figure 3. The annual cycle of upwelling at representative west coast locations. The diamonds denote the mean of the monthly upwelling indices for each calendar month for the period 1967-91. The vertical bars denote +/- one standard deviation for each calendar month. The bold curve is a biharmonic fit to the daily upwelling indices for the period 1967-91. The shaded area around the biharmonic curve denotes +/- one standard error, calculated for each Julian Day.

Rapid advancements in computing and communications since the initial development of the upwelling index over two decades ago have led to more accurate and efficient calculation and distribution of the upwelling products. The upwelling indices and many other PFEG data products are now available on the Internet at **http://www.pfeg.noaa.gov**.

Although the upwelling indices are by far the most popular product PFEG derives from the surface pressure fields, they are but one of several atmospheric and oceanic products generated from the six-hourly pressures. A future technical memorandum will summarize some of the more important products. (F. B. Schwing, 408-648-9034)

Cooperative Workshop Examines the Role of Environmental Data in Fisheries

The role of NMFS in research, management, and enforcement of regulations for fisheries and pro-

tected species involves a broad range of activities affected by environmental variability. A workshop funded by NOAA's Earth System Data and Information Management Program was co-convened by PFEG Oceanographer George Boehlert and Jim Schumacher of the Environmental Research Laboratories' Pacific Marine Environmental Laboratory at the PFEG facility in Pacific Grove, California. The participants examined how environmental data are applied to practical problems in fisheries research and management. The objectives of the workshop were to assess the current and future needs for environmental databases (oceanographic, atmospheric, remote sensing, model output, geological) in fisheries and fisheries-related ecosystem research, to identify data sources and formats, and to recommend ways to facilitate access to the data.

More than 50 scientists with expertise in fisheries, physical sciences, environmental data, and computers participated in the meeting. Presentations by fisheries scientists described uses of environmental data in fisheries research and management; physical and computer scientists described sources of environmental data, including that from ocean models and geophysical investigations, and how they are managed. Internet and video-based demonstrations described ocean model output and data management systems.

Open discussions were a very important element of the workshop; four working groups addressed real-time or near real-time environmental data applications to fisheries, retrospective environmental data applications to fisheries, applications of oceanographic and atmospheric model output to fisheries, and data delivery systems, data accessibility criteria, and formats. An additional working group was convened to address opportunities and mechanisms for inter-agency cooperation.

The working groups developed more than 40 recommendations. A common thread among the working groups was the need for improved communication among fisheries scientists, oceanographers, and the physical and computer scientists who provide model and environmental data. Consensus was that follow-up workshops, focused on specific topics (for example, model data applications, remote sensing, and fisheries), be developed. Applications of new environmental technology, including remotely sensed data, multi-beam sonar technology, and numerical model output, were highly recommended. Parallel efforts among different agencies were identified, leading to suggestions to promote collaboration and increase the interoperability among existing environmental data access systems. The working group on partnerships for fisheries oceanography recognized the critical need for cooperation and collaboration to identify and fully utilize all environmental data and to model output that could be beneficial to NOAA's environmental stewardship mission.

The workshop proceedings will be published as a NOAA Technical Memorandum. A short workshop report and the full text of recommendations are available on the Internet at **http://www.pfeg.noaa.gov/workshop**.
(G. Boehlert, 408-648-8447)

PFEG'S Historical Data Archives Transferred from Navy Computers to IT-95 System

Beginning with its inception in 1969, PFEG established, and has maintained, a strong cooperative relationship with the Navy's Fleet Numerical Meteorology and Oceanography Center. The Navy periodically seeks practical comments on model development results from PFEG research staff, for whom the center has been a consistent source of observational data sets and meteorological and oceanographic model products.

Oceanographic and meteorological data are at the heart of PFEG's research. While collecting and processing data for its research efforts, PFEG has made extra efforts to make data available for fisheries and other researchers. Researchers chose not to repeatedly access and rely on the formal data resources of the center, which include hundreds of products and thousands of observations of little or no interest to PFEG researchers. Instead, PFEG scientists extracted subsets of interest from those archives and maintained their own informal archives of data and model products. The data and products were retained and used on center systems in the form as acquired, using applications PFEG developed along with tools developed by the Navy to produce a suite of monthly and special products (for example, the Bakun Upwelling Index).

The center has undergone a transition to modernize its computer systems to Cray supercomputers and Sun workstations. In response to those changes, PFEG transferred its historical data archives to the IT-95 server at its Pacific Grove facility and established communication paths to assure consistent and ready access to data and products from the Navy. Successful conversion of monthly and special applications, completion of the PFEG archival transfer, and establishment of near real-

time data acquisition from the center concentrate the processing action onto the IT-95 server. This will also allow for development of new index time series from the archives by modifying computer programs presently being converted. (A. Stroud, 408-648-9037)

PELAGIC FISHERIES RESOURCES DIVISION

La Jolla, California

TUNA/BILLFISH ASSESSMENT PROGRAM

Annual Shark Abundance Survey Completed

A survey to index shark abundance within the Southern California Bight was conducted from August 10-29, 1996, aboard the NOAA research vessel *David Starr Jordan*. Survey objectives were to (1) collect data on shark abundance for population indexing, (2) tag and release live and healthy sharks, (3) collect biological data and samples, including reproductive organs, muscle and heart tissue, stomach contents, and whole specimens, for several ancillary studies, and (4) collect data on by-catch species.

Forty-four longline sets were made within the Southern California Bight, involving a total of 6,211 hooks. Thirty-three sets were made using wire cable leaders during daylight hours, and 11 sets with monofilament nylon were made during nighttime hours. Total catch was 205 shortfin mako sharks (*Isurus oxyrinchus*), 689 blue sharks (*Prionace glauca*), 74 pelagic stingrays (*Dasyatis violacea*), and one swordfish (*Xiphias gladius*). One California sea lion (*Zalophus californianas*) and one common mola (*Mola mola*) were foul-hooked (snagged) during fishing operations. Both were released without harm. Overall catch rate of sharks was 14.4 sharks per 100 hooks. Catch rate for shortfin mako sharks averaged 4.0 per 100 hooks but was more than double—8.5 per 100 hooks—in the most productive survey areas.

A total of 556 blue sharks and 164 shortfin mako sharks were tagged and released for population and movement studies. Necropsies were conducted on 52 blue sharks, 31 shortfin mako sharks, and one swordfish. Heart, liver, gonad, and muscle tissue were collected for a variety of studies including reproductive condition, DNA analysis, heavy metal and DDT concentrations, and biochemical analysis. Stomachs were collected for feeding pattern studies. Fifty-three pelagic stingrays were collected for ageing and growth studies. Four whole blue sharks were collected for observer shark identification and anatomy training. Physiological studies of swimming energetics were conducted on four shortfin mako sharks and six pelagic stingrays in a variable-speed water tunnel aboard the vessel.

Mexican scientists from Instituto Nacional de la Pesca, Universidad Autonoma de Baja California Sur, and Centro de Investigacion Cientifica y de Educacion Superior de Ensenada, and U.S. scientists and student volunteers from NMFS, California Department of Fish and Game, Scripps Institution of Oceanography, Moss Landing Marine Laboratory, Monterey Bay Aquarium, and California State University at Los Angeles participated in the cruise. (D. Holts, 619-546-7186)

Newsletters Now Available on the World Wide Web

Two popular newsletters produced by the Pelagic Fisheries Resources Division are now available on the World Wide Web. Each issue of the *Tuna Newsletter* and the *Billfish Newsletter* is posted to the SWFSC's Web site at about the same time that it is mailed to regular subscribers. Back issues are available for 1995 and 1996. The electronic versions of these newsletters contain all the original text, tables, and figures, and other useful information.

The *Tuna Newsletter* is published quarterly by the Southwest Region and SWFSC to inform constituents and the general public of the status of U.S. tuna fisheries, the canned tuna industry, and research conducted at the SWFSC and associated organizations. Each issue also provides a calendar of upcoming meetings and conferences and summarizes tuna news stories from around the world.

The *Billfish Newsletter* is an annual publication produced by the SWFSC as a service to the international billfish angling community, with an emphasis on billfish angling in the Pacific, Indo-Pacific and Indian oceans. The results of the International Billfish Angler Survey and the Cooperative Marine Game Fish Tagging Program, which are managed by the SWFSC, are described in each issue.

The *Tuna Newsletter* and the *Billfish Newsletter* can be found on the Web at **http://swfsc.ucsd.edu**. (A. Jackson, 619-546-7046)

TIBURON LABORATORY

Tiburon, California

GROUNDFISH ANALYSIS INVESTIGATION

14th Annual Juvenile Rockfish Survey Completed

A research cruise aboard the NOAA research vessel *David Starr Jordan* was conducted by fishery biologists of the Groundfish Analysis Investigation from May 17 to June 20, 1996. The survey (DSJ-9606) was designed to study the distribution and abundance of pelagic-staged juvenile rockfish (*Sebastes* spp.) in an attempt to identify factors contributing to variability in annual spawning success.

Juvenile rockfish samples were obtained from midwater trawls conducted at night during three sweeps of an area off the central California coast from Monterey Bay (36°N) to Point Reyes (38° 10'N) (Fig. 1). A modified Cobb midwater trawl with a 26-m headrope and 1-cm liner was towed for 15 minutes at depth at five or six stations per night. Ship speed was maintained at 2.7 knots while trawling. Target headrope depths were 7, 30 and 100 m and were recorded during each tow by a time-depth recorder attached to the upper bridle.

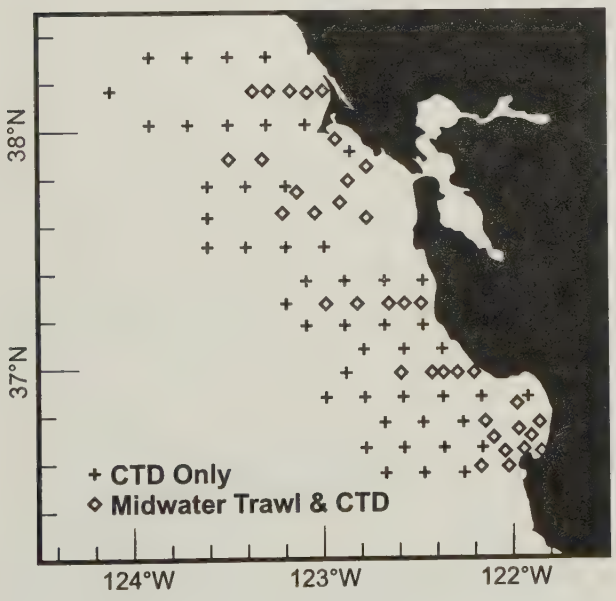

Figure 1. Map of midwater trawl and CTD stations during juvenile rockfish survey DSJ-9606.

One hundred sixteen midwater trawls were completed. Most of the juvenile rockfish sampled were small (15-25 mm), although the "blackspot group," which consisted of blue, yellowtail, and black rockfish, ranged in length from 30-40 mm. For the third straight year, juvenile rockfish catch was low (Table 1, see page 10). The total non-shortbelly rockfish catch was the lowest since the three-sweep method was instituted in 1986; the catch of invertebrates and other fish species was also low.

Two hundred ninety conductivity-temperature-depth (CTD) casts were completed throughout the day in the vicinity of the midwater trawl transects and at each night trawl station. Temperature and salinity data were obtained and chlorophyll and light levels were measured. Water samples were taken twice daily for fluorometry and salinity calibrations. Upwelling was intense during the cruise with sea surface temperatures in the 9-10°C range (Fig. 2). Chlorophyll, light level, and current data will be analyzed at a later date.

One of several ancillary projects was to determine the distribution and abundance and diel migratory behavior of larval crabs (*Cancer* spp.) and rockfishes relative to the hydrographic features on the shelf between Bodega Head and Point Arena. Twenty-two Tucker trawls and nine manta tows were conducted in the Gulf of the Farallones and

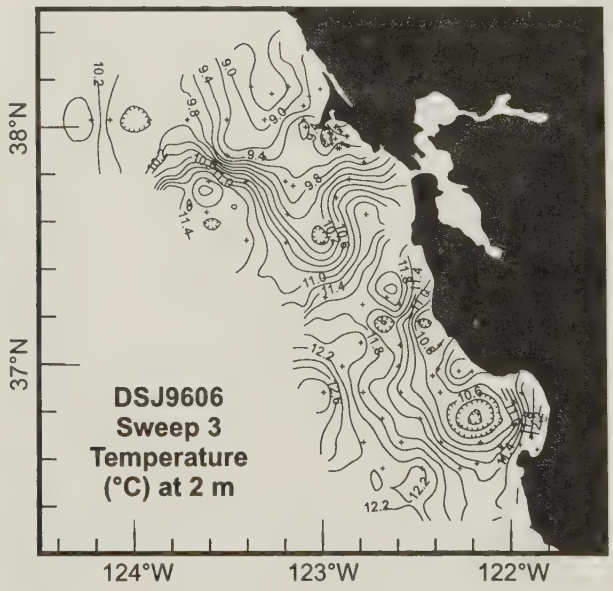

Figure 2. Contours of sea surface temperature (°C) measured by CTD probe during the third sweep of juvenile rockfish survey DSJ-9606. CTD stations are represented as + symbols. Contours with hatch marks represent cooler waters.

Table 1. Number of pelagic young-of-the-year rockfish collected by midwater trawl at standard stations and depths during May-June cruises (1986-96).

Species	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Shortbelly	9,104	6,865	107,962	1,598	4,479	2,422	2,838	2,287	966	275	1,821
Chilipepper	54	586	4,418	24	66	343	90	1,251	3	32	14
Brown	470	10	-	3	19	265	7	1,226	17	5	16
Widow	11	424	257	13	296	623	1	101	23	26	-
Squarespot	4	177	380	16	649	47	70	25	-	-	-
Canary	46	71	162	39	23	618	-	14	3	1	-
Blue	4	196	366	63	38	220	-	37	11	7	5
Stripetail	2	194	30	6	22	175	5	315	9	6	2
Bocaccio	327	106	60	22	44	114	5	26	4	3	1
Yellowtail	22	85	69	31	27	281	5	31	7	30	3
Copper complex	9	9	1	-	1	15	116	82	2	7	2
Pygmy	2	15	9	12	10	62	8	2	3	-	1
Halfbanded	1	9	-	2	77	8	1	5	2	-	5
Black	1	22	19	5	4	34	-	6	2	6	6
Olive	-	4	2	6	18	-	-	6	1	-	-
Darkblotched	-	7	5	-	1	9	-	9	-	2	-
Cowcod	1	17	1	1	-	-	5	5	-	-	-
Bank	-	18	4	-	-	-	-	5	-	-	-
Sabastomus	2	7	3	-	1	3	8	-	-	1	2
Splitnose	1	4	-	-	1	-	19	-	-	-	-
Puget Sound	-	-	-	-	-	22	-	-	-	-	-
Sharpchin	-	-	-	-	-	18	2	-	-	-	-
Grass	1	1	-	-	-	-	8	2	-	-	-
Quillback	2	1	-	-	-	6	-	-	-	-	-
Vermillion	-	4	-	-	1	1	-	-	-	-	-
Copper	-	-	-	-	-	-	1	-	-	-	3
Greenstripe	-	3	-	-	-	-	-	-	-	-	-
China	-	2	-	-	-	-	-	-	-	-	-
Greenspotted	-	-	-	-	-	-	1	-	-	-	-
Unknown	40	-	-	-	2	4	49	31	84	13	66
Totals	10,104	8,837	113,748	1,841	5,779	5,290	3,242	5,466	1,137	414	1,945

southwest of Point Arena. The depth bins for the Tucker trawl were 0-40 m and 40-100 m, as bottom depth allowed. The catch will be identified at a later date and the data will be used to determine the influence that upwelling-relaxation episodes have upon distribution of juvenile rockfish and crab megalopae. (D. Woodbury, 415-435-3149, ext.218)

Two Surveys Conducted to Monitor Offshore Dump Site

Fishery biologists in the Groundfish Analysis Investigation completed two surveys to monitor possible effects on marine life of dredged materials at an offshore disposal site, known as the San Fran-

cisco deep ocean dredged materials disposal site, located 25 nmi west of the Farallon Islands. These surveys involved collaboration with ornithologists from the Point Reyes Bird Observatory and H.T. Harvey and Associates, and scientists from the U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers.

The first survey occurred June 2-7, 1996, during the Tiburon Laboratory's annual juvenile rockfish survey aboard the NOAA research vessel *David Starr Jordan*. Both the disposal site and a control site 25 nmi south were surveyed. Thirty-seven midwater trawls were conducted at night to collect juvenile fish and euphausiids. The catch was dominated by offshore species, such as squid (non-*Loligo* sp.), myctophids, and sergestids.

The second survey was conducted September 17-22, 1996, aboard the Moss Landing Marine Laboratory's research vessel *Point Sur*. Net sampling of juvenile fish and euphausiids was conducted at the disposal site stations and additional stations along the perimeter of the disposal site stations. Many unidentified juvenile rockfish were collected which comprise a "summer spawning" group. One exceptional catch of euphausiids occurred in an area a few miles east of the disposal site, where a large concentration of birds and marine mammals also was observed.

Ornithologists from H. T. Harvey and Associates and the Point Reyes Bird Observatory recorded the distribution and abundance of sea birds and marine mammals during daytime transects between CTD stations. Birds and mammals were sparse where depths exceeded 1500 m (including the disposal site), but were abundant along the upper shelf break (to 400 m depth). Especially large concentrations of birds and cetaceans were encountered at the upper end of Pioneer Canyon. About 20 species of birds, three species of pinnipeds, four species of whales, and four species of dolphins were observed, which is not unusual for the early fall in this region.

Several physical oceanographic parameters were also measured during the cruise, including currents, temperature, and salinity. The information collected will be analyzed to help determine whether disposals have affected abundances of important small fishes, invertebrates, marine mammals, and sea birds, and if their physiological condition was poorer at the disposal site than other areas. (D. Woodbury, 415-435-3149, ext.218)

GROUNDFISH PHYSIOLOGICAL ECOLOGY INVESTIGATION

Physiological Ecology of Juvenile Fall-Run Chinook Salmon Studied in the San Francisco Estuary during 1995

In April 1995, the Physiological Ecology Investigation started a multi-year study of the physiological development of out migrating juvenile chinook salmon (*Oncorhynchus tshawytscha*). The goal of this research is to determine the interannual variability of growth, development, and health within the San Francisco estuary and near-coastal system and the influences of biotic and abiotic environmental factors. During April to June 1995, approximately 900 juveniles were collected and analyzed from locations spanning the estuary. Fish were obtained from the head of the estuary at the Sacramento River-San Joaquin River Delta, hatchery plants, San Francisco Bay, and the near-coastal ocean (Gulf of the Farallones).

Results from fall-run chinook juveniles captured in 1995 included estimates of residence time, growth, and energy status. Based on age estimates from otolith analysis, juveniles spent 28 ± 2 days transiting the estuary. During that span, the fish showed a slight, but significant, gain in length and weight (P=0.01) (Fig. 3). However, those captured in the Gulf of the Farallones shortly after leaving the estuary (mean age = 164 ± 4 days compared to 162 2 days for those caught in the estuary) showed greatly increased size (39% increase in fork length, 312% increase in weight), indicating the beneficial nature of ocean entry. Researchers found no significant differences in protein concentrations in whole fish sampled among collecting locations, suggesting protein was not catabolized for energy. Total lipid concentrations, however, declined significantly ($P<0.05$) between juveniles entering the estuary and those in San Francisco Bay. Significant declines ($P<0.001$) in triacylglycerols (the primary form of lipid storage) further establish the importance of lipids to energy metabolism during outmigration. When triacylglycerols (TAG) were presented as ratios to cholesterol (CHOL) in salmon (a technique that expresses the amount of TAG relative to the amount of tissue present), a progressive decline of stored energy was evident as the juveniles transit the estuary and initiate the ocean phase of life (Fig. 4).

Contaminant analyses revealed that livers from juvenile salmon collected in San Francisco Bay con-

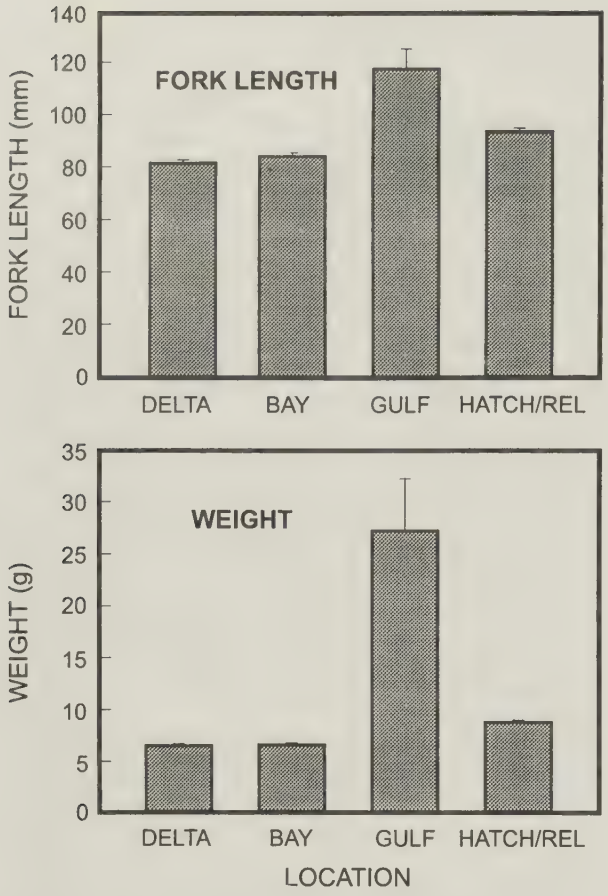

Figure 3. Fork length (mm) and wet weight (g) of juvenile fall-run chinook salmon collected at locations in the San Francisco Estuary and the Gulf of the Farallones during April-June 1995. Salmon were obtained from the Sacramento-San Joaquin Delta (Delta), San Francisco Bay (Bay), Gulf of the Farallones (Gulf) and hatchery releases (Hatch/Rel). Values are means; error bars denote standard error.

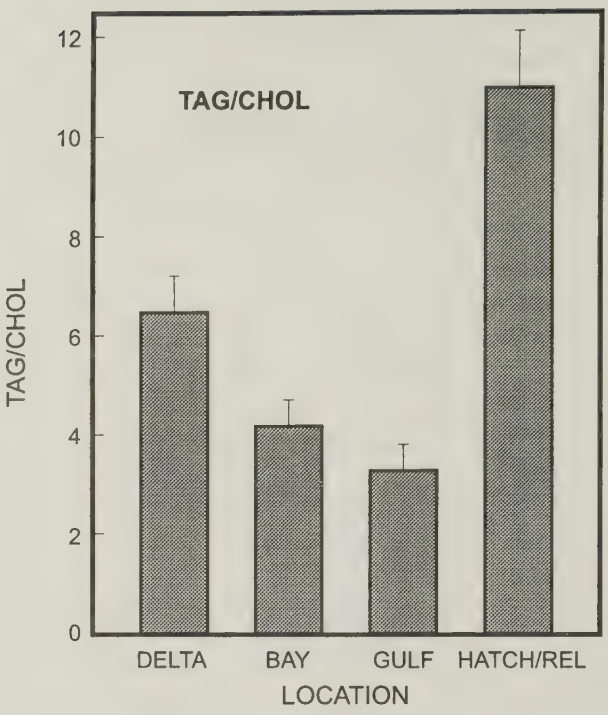

Figure 4. Ratio of triacylglycerols (TAG) to cholesterol (CHOL) in juvenile fall-run chinook salmon collected at locations in the San Francisco Estuary and Gulf of the Farallones.

tained significantly greater concentrations of Σ chlordanes, Σ DDTs, and Σ PCBs than fish from the delta or hatcheries ($P<0.05$). This suggests significant sources of organic contaminants originate within the estuary. Polycyclic aromatic hydrocarbon concentrations in livers did not vary among locations. Organic contaminants in stomach contents were not significantly different among locations, except for Σ DDT which was elevated in fish caught in the delta. Unmetabolized DDT was found in 80% of field samples. In general, levels of organic contaminants were three- to ten-fold lower in fish collected in 1995 compared to those assessed in 1992 by researchers from the NMFS Northwest Fisheries Science Center (unpublished report by Usha Varanasi submitted to the NMFS Southwest Region). Of 11 metals assessed in composited whole fish samples, only copper and zinc concentrations were significantly elevated in fish obtained in San Francisco Bay compared to those entering the estuary at the delta ($P<0.0001$). Since 1995 was a very wet year with high freshwater outflow and 1992 was a drought year with low outflow, the difference in contaminant concentrations may be a function of freshwater flow. Contaminant analyses in more years of varying water flows may confirm this contention.

The profile of the physiological development of juvenile fall-run chinook salmon during the outmigration in 1995 provides a basis for comparison to subsequent outmigrations. Should environmental conditions vary during the remaining study period of 1997 to 1999, such as a return to drought conditions typical of the late 1980s and early 1990s, physiological and ecological differences in juvenile outmigrants among both wet and dry years may reveal physiological differences influenced by environmental factors. (R. B. MacFarlane, 415-435-3149, ext.244)

INFORMATION TECHNOLOGY SERVICES

UNIX Computer Specialist Vacancy Filled; Computer Upgrades Completed

Richard Cosgrove was selected for a UNIX computer specialist vacancy and started working for Information Technology Services in September. His duties are primarily UNIX system administration and scientific application programming support. Cosgrove previously worked under contact for the Coastal Fisheries Resources Division's Coastwatch Program. His experience with UNIX systems and Coastwatch satellite data and his educational background in geographic information systems (GIS) will be useful in developing in-house GIS applications.

Information Technology Services staff completed major hardware and software upgrades on the La Jolla Laboratory's SGI Challenge L computer. The hardware upgrades consisted of 72GB of disk, 128MB of RAM, a high-capacity digital linear tape stacker backup device (280GB total capacity), and a Lexmark color jet printer capable of printing tabloid size (11 by 17 in) paper. Several new software packages were installed, including True Basic, ImageAlchemy (graphics conversion software), Vista Extend, Arc/Info GIS, Arc/View GIS, and S-PLUS. (R. Bistodeau, 619-546-7055)

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Eldridge, M. B., and B. M. Jarvis. 1996. Development and energy utilization in early life stages of viviparous yellowtail rockfish. *In* D. MacKinlay and M. Eldridge (eds.), The fish egg: Its biology and culture, p. 131-140. International Congress on the Biology of Fishes, American Fisheries Society, Physiology Section, July 14-18, 1996, San Francisco State University.

Laboratory experiments were conducted with gestating adult yellowtail rockfish and field surveys were

completed of females in late vitellogenesis and gestation to determine the rate of embryonic and larval development, to examine the different measures of egg quality, and to determine the rate of endogenous energy utilization and tissue assimilation. Embryogenesis and larval development followed a predictable sequence and showed rapid development with hatching occurring in 23 days and parturition in 29 days. Eggs varied in dry weight and energy content with lipid concentrations most directly contributing to the amount of energy per egg. The endogenous energy of yolk and oil globule declined rapidly throughout gestation resulting in limited yolk and oil reserves at parturition. Findings of this research will allow estimation of stock biomass and will further understanding of the underlying factors that contribute to recruitment variation.

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Concentrations of total lipid, protein, and lipid classes were determined in oocytes and embryos from two species of viviparous rockfishes: yellowtail rockfish (*Sebastes flavidus*) and shortbelly rockfish (*Sebastes jordani*). Total lipid, protein, triacylglycerols, sterol/wax esters, nonesterified fatty acids, cholesterol, and polar lipids declined during embryo development. Regression analysis of changes in lipid and protein variables depending on the stage of embryo maturation found highly significant linear relationships. By solving regression equations for the final stage of embryo development, estimates of the lipid and protein concentrations at birth were obtained. These values provide an estimate of the nutritional and structural biochemical composition of larvae at their earliest life history stage in the environment, and thus, an assessment of larval condition and reproductive quality. Data revealed significant differences in the dynamics of lipid and protein depletion during embryogenesis between the two rockfish species and among three populations of shortbelly rockfish located at Ascension, Pioneer, and Bodega submarine canyons. Estimated concentrations of lipids and protein at birth were significantly greater in shortbelly rockfish larvae from Ascension Canyon than in those from Pioneer and Bodega Canyons in 1994, suggesting a greater potential survival during the time period following birth when planktonic food resources are often limited. The technique presented here to assess reproductive quality or the condition of progeny can be applied in field studies of viviparous teleosts and does not require detailed laboratory investigations of embryo development.

MacKinlay, D., and M. Eldridge (eds.). 1996. The fish egg: Its biology and culture. International Congress on the Biology of Fishes, American Fisheries Society, Physiology Section, July 14-18, 1996, San Francisco State University, 192 p.

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Two designs of artificial shelters were evaluated for use in the artisanal spiny lobster fishery in Gazi Bay, Kenya. Both types of shelter were effective in aggregating the spiny lobster *Panulirus ornatus* in nearshore seagrass beds. Lobsters aggregatedat the shelters were caught by free-diving fishermen, using spearguns and hand nets. Mean lobster catches taken from the shelters ranged from 0.38 to 0.83 $kg \cdot trip^{-1}$, around 50% of those taken farther offshore in natural reefs. No significant difference was found in the size or sex composition between shelter and reef-caught lobsters.

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Northern bluefin tuna (*Thunnus thynnus*) apparently spawn only in the western Pacific, and a portion of the juveniles migrate to the eastern Pacific. During the past decade, catches of northern bluefin in the eastern Pacific have declined. One possible cause for this decline, proposed by bluefin stock assessment studies, is a decline in the proportion of bluefin migrating out

of the western Pacific. This hypothesis is examined with several indices of the relative abundance of bluefin tuna in the western and eastern Pacific. These indices suggest a decline in the proportion of bluefin migrating to the eastern Pacific since 1977. This period of reduced bluefin migration coincides with a period when a prey of bluefin, Japanese sardine (*Sardinops melanosticta*), were abundant off Japan. It is hypothesized that in years when sardines are abundant off Japan, a higher proportion of bluefin stay in the western Pacific compared with years when sardines are scarce. Currently, the abundance of sardines off Japan is declining. If this decline continues, this hypothesis predicts an increase in bluefin migrating north of Hawaii and into the eastern Pacific.

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Approved by Science Director, SWR

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Aguirre, A. A., T. R. Spraker, and G. H. Balazs. Spirorchidiasis in green turtles (*Chelonia mydas*) with fibropapillomatosis in the Hawaiian Islands. For consideration for publication in Journal of Wildlife Diseases.

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Administrative Reports are strictly for internal use only and are not to be cited or treated as publications.

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